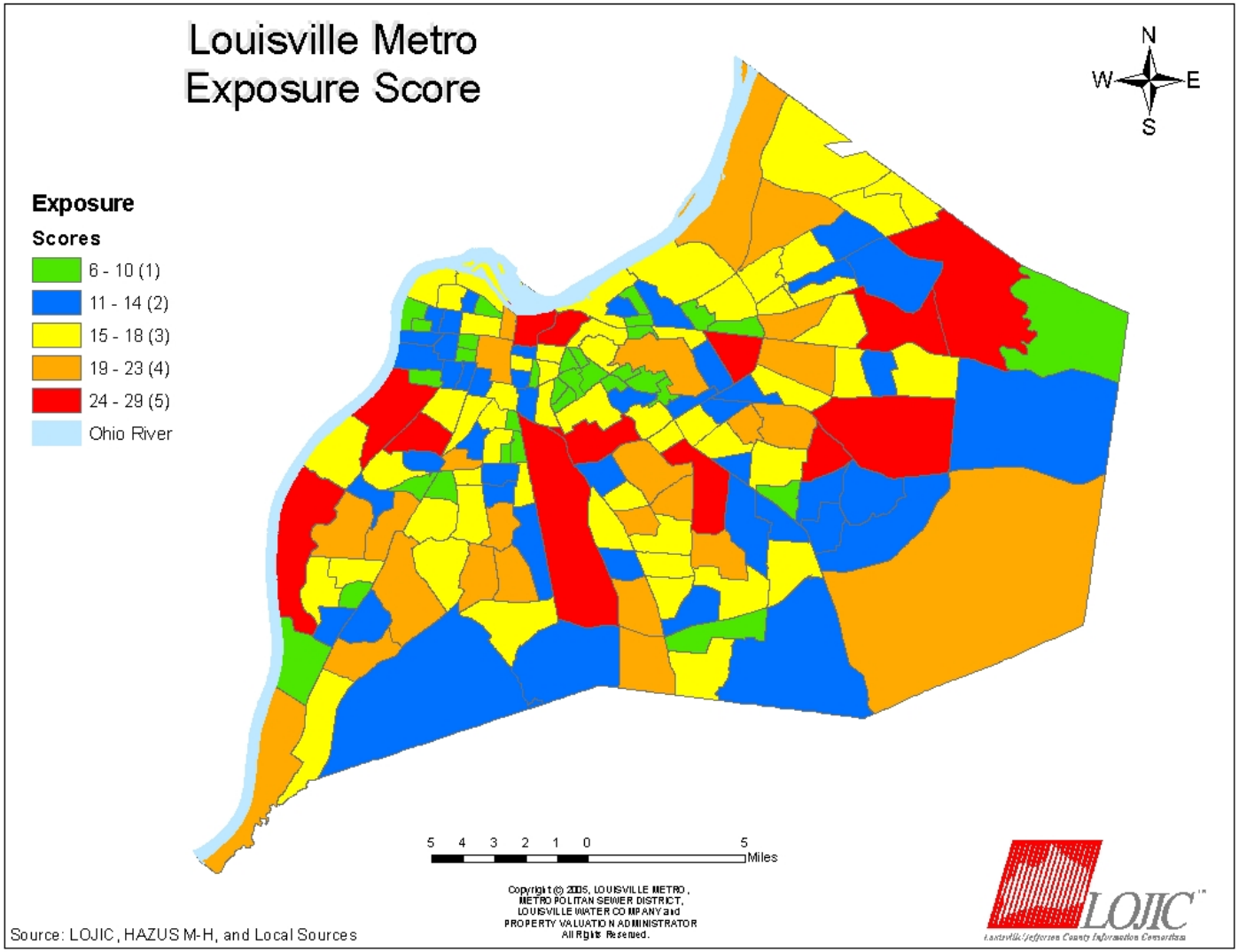
Exposure Map



The Exposure Score is derived by totaling the following rankings: population, building, essential facilities, utility facilities, social vulnerability, potential high loss, and transportation facilities.

Calculating the Hazard Score

Hazard Score = Occurrence Rank OR Area Affected Rank

When measuring vulnerability, the effects of natural hazards on Louisville Metro census tracts had to be measured. The Hazard Score assigns a hazard variable to the Hazard Vulnerability Score. The hazard score is represented by one of two variables: **area effected rank** or **occurrence rank**. These two variables were chosen because of the differences in information recorded for natural hazards. Some hazards have boundaries for analysis; such as flooding, while total numbers of occurrences are best used to analyze those hazards occurring anytime or anywhere, such as tornadoes.

Vulnerability Assessment of Drought, Extreme Heat, Hail, Severe Winter Storm, Severe Storm (includes Lightning), Tornado, and

Occurrence Rank - Due to the size of the Louisville Metro area and the census tract's within, Drought, Extreme Heat, Hail, Severe Winter Storm, Severe Storm, Tornado, and Wildfire have the potential of affecting the entire county when they occur. When combined with the unpredictability of these hazards it can be assumed that these hazards have an equal probability of occurring in all census tracts at any given time. In other words, no one census tract is more likely to experience these hazards than any other. (See Occurrence Rank Maps below.) Thus, the only determination of vulnerability is the Exposure Score. Those census tracts with a higher Exposure Score are more vulnerable to Drought, Extreme Heat, Hail, Severe Winter Storm, Severe Storm, Tornado, and Wildfire.

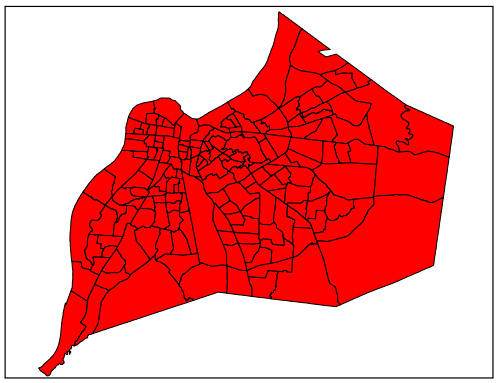
Predicting location and magnitude of the above hazards is not possible, but, by listing past number of occurrences from the years 1960-2000, derived from local NCDC, and Mid-West Climate Center databases, it can be shown 1) which of the six hazards have occurred most often (See Table below) and, 2) by ranking these occurrences, which hazards are more likely to occur in the future.

Occurrence Rank Table

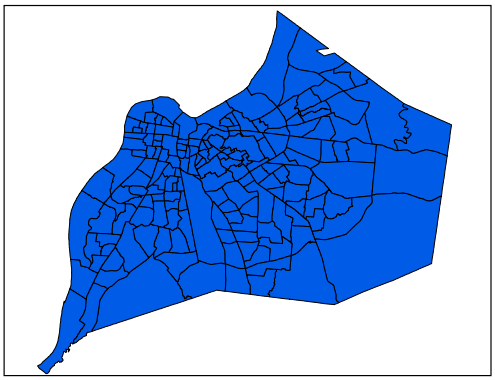
Hazard	# of Occurrences	Occurrence Rank
Severe Storm	77	5
Hail	24	4
Extreme Heat	16	3
Winter Storm	15	3
Drought	12	2
Tornado	8	1

Occurrence Rank Maps

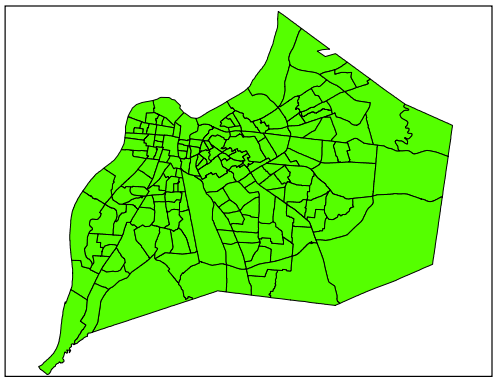
Severe Storm Occurrence Rank = 5



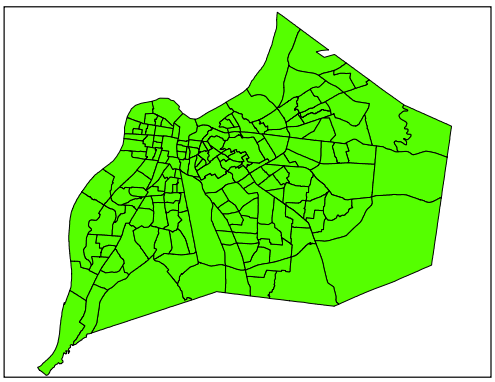
Hail Occurrence Rank = 4



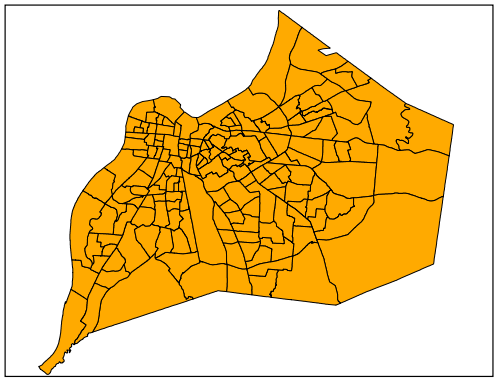
Winter Storm Occurrence Rank = 3



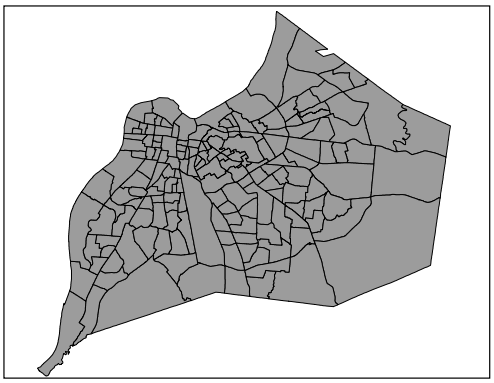
Extreme Heat Occurrence Rank = 3



Drought Occurrence Rank = 2



Tornado Occurrence Rank = 1



Vulnerability Assessment of Dam Failure, Earthquake, Flood, Karst/Sinkhole, Landslide, and Wildfire

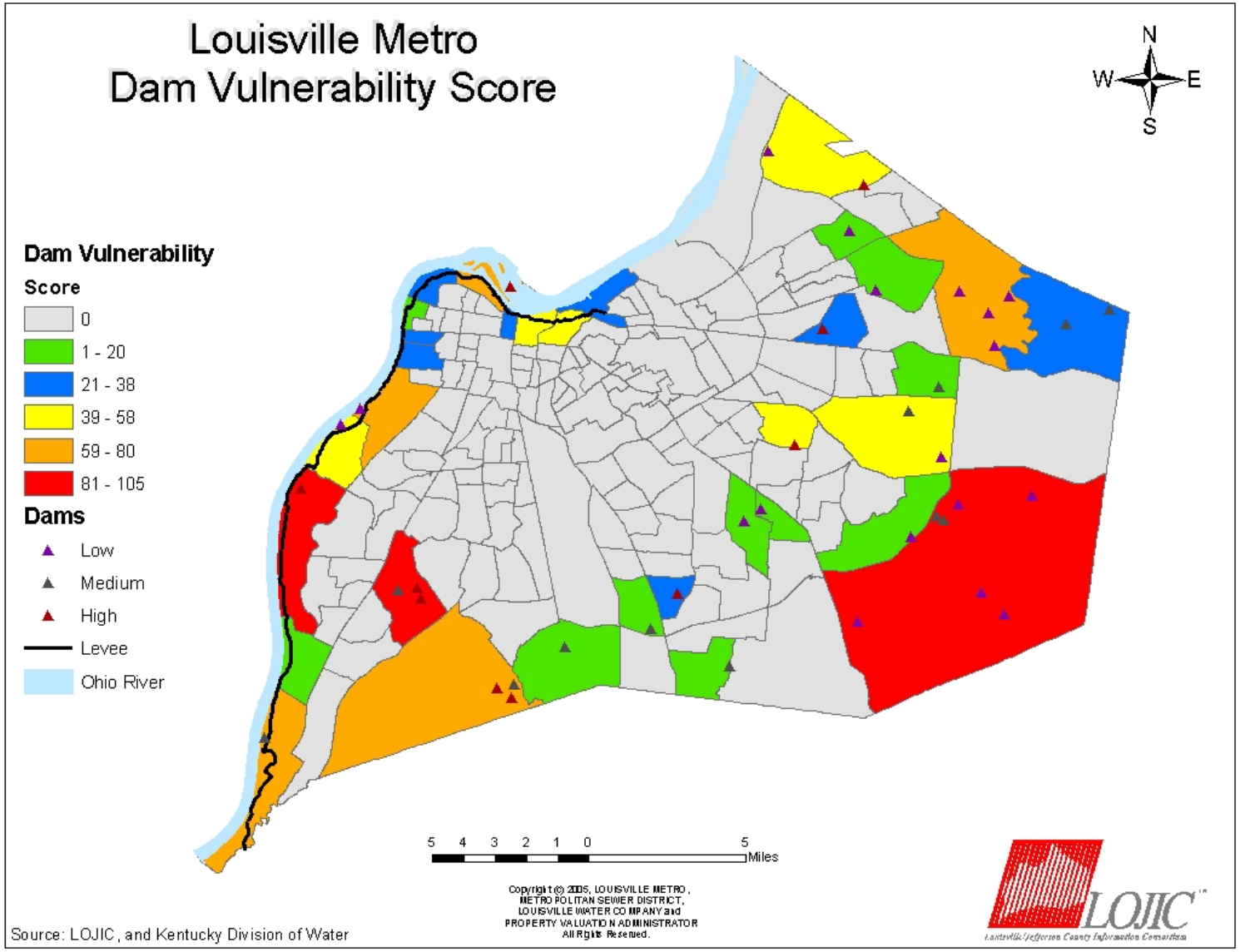
This section illustrates each census tract's vulnerability to Dam Failure, Flood, Karst/Sinkhole, Landslide, and Wildfire based on the area affected by each hazard.

For HAZUS-MH Pilot project) Earthquake Vulnerability Assessment, see Appendix 12.

Area Affected Rank – Percent of each census tract's total area that is affected by the hazard. The area affected boundary files were obtained from different data sources discussed in the Hazard Vulnerability sections. The area affected in each census tract, by each of the above hazards, was calculated, and then ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS. This produced a Hazard Score for each of the above five hazards.

Once the Hazard Score were determined, the equation was set into motion to produce a Hazard Vulnerability Score, per hazard, for each census tract. The Hazard Vulnerability Scores contain some bias toward the more populated census tracts. This is due to a correlation between more populated areas and their tendency to have higher numbers of critical facilities, properties, transportation facilities, etc. This resulted in higher populated census tracts having greater exposure. However, with the data provided, other equations can be developed with or without one or more variables, or a different weighting system. The goal of this model was to assess the most vulnerable areas throughout the county. Since the most populated areas have the most at risk, this model achieved that goal.

Dam Failure Vulnerability Map



First counting and categorizing dams within each census tract as high, medium, and low hazard dams determined a Dam Failure Vulnerability Score. This information was obtained from the Kentucky Division of Water.

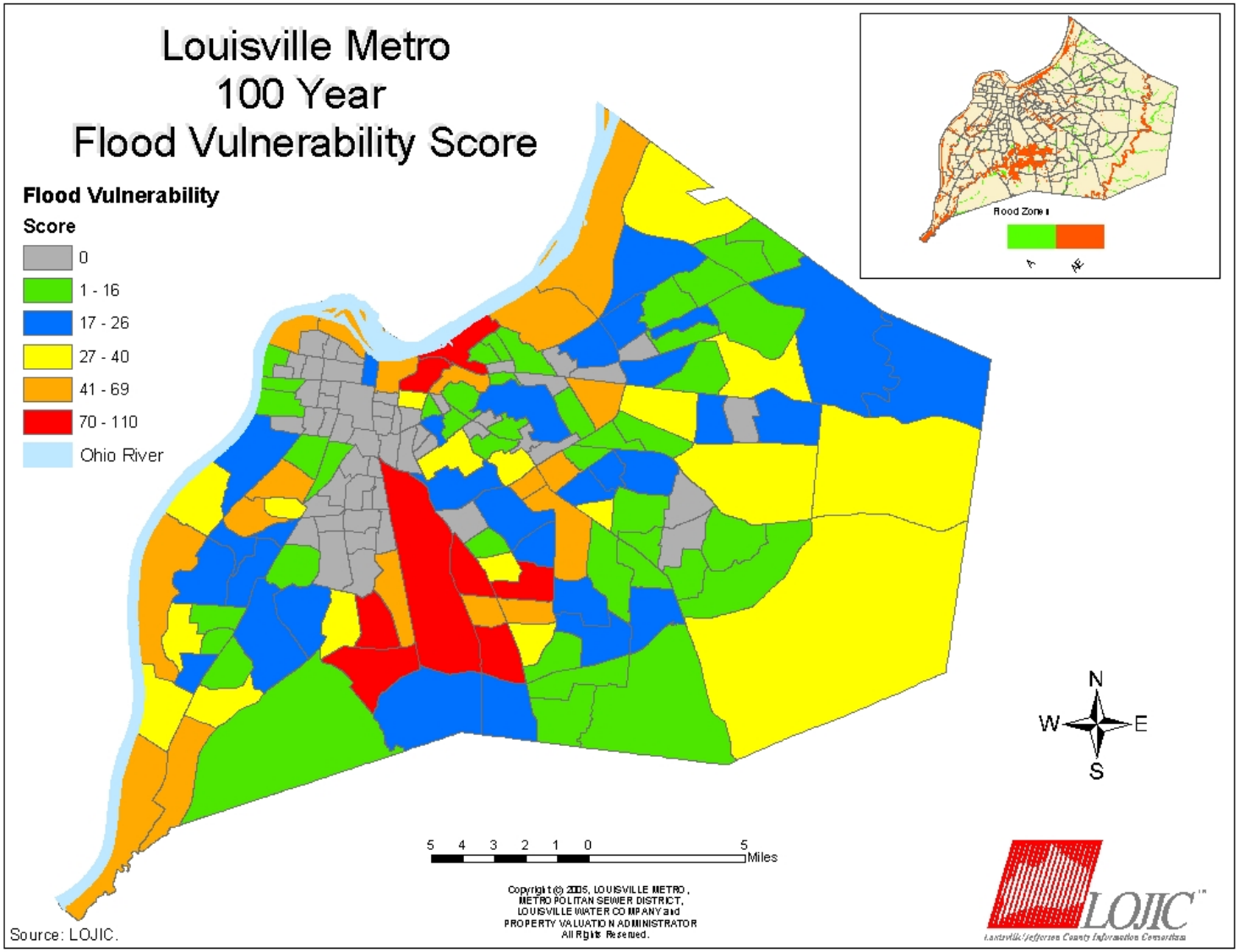
Fourteen (14) Louisville Metro census tracts contain a levee. This levee was categorized as a high hazard dam and scored the same as all other high hazard dams.

There are ten (10) high hazard dams as classified by the Kentucky Division of Water; but, when the levee is added into those census tracts containing it, the high hazard dam total increases to twenty-four (24). Those census tracts containing the levee are highlighted in gray within the Dam Failure Vulnerability Table. This method also increases the total number of dams from forty (40) to fifty-four (54).

A high hazard dam was given a score of 3, medium a score of 2, and low a score of 1. Second, scores for high, medium, and low hazard dams were added together producing a total dam score for each census tract (See Dam Failure Vulnerability Table Appendix 13). Next, census tracts were ranked 1-5 (1=low, 5=high) based upon their total dam score producing a Hazard Score. Finally, a Dam Failure Vulnerability Score was calculated for each census tract by multiplying a census tract's Exposure Score by its Hazard Score.

Note: Some census tracts have zero dams which equaled a 0 Total Dam Score, and a 0 Hazard Score; thus, equaling a 0 Dam Failure Vulnerability Score.

100 Yr. Flood Vulnerability Map



Once it is known that a census tract contains a 100-year floodplain, it must be determined how vulnerable that census tract is to this flood event having a 1% probability of occurring in any given year.

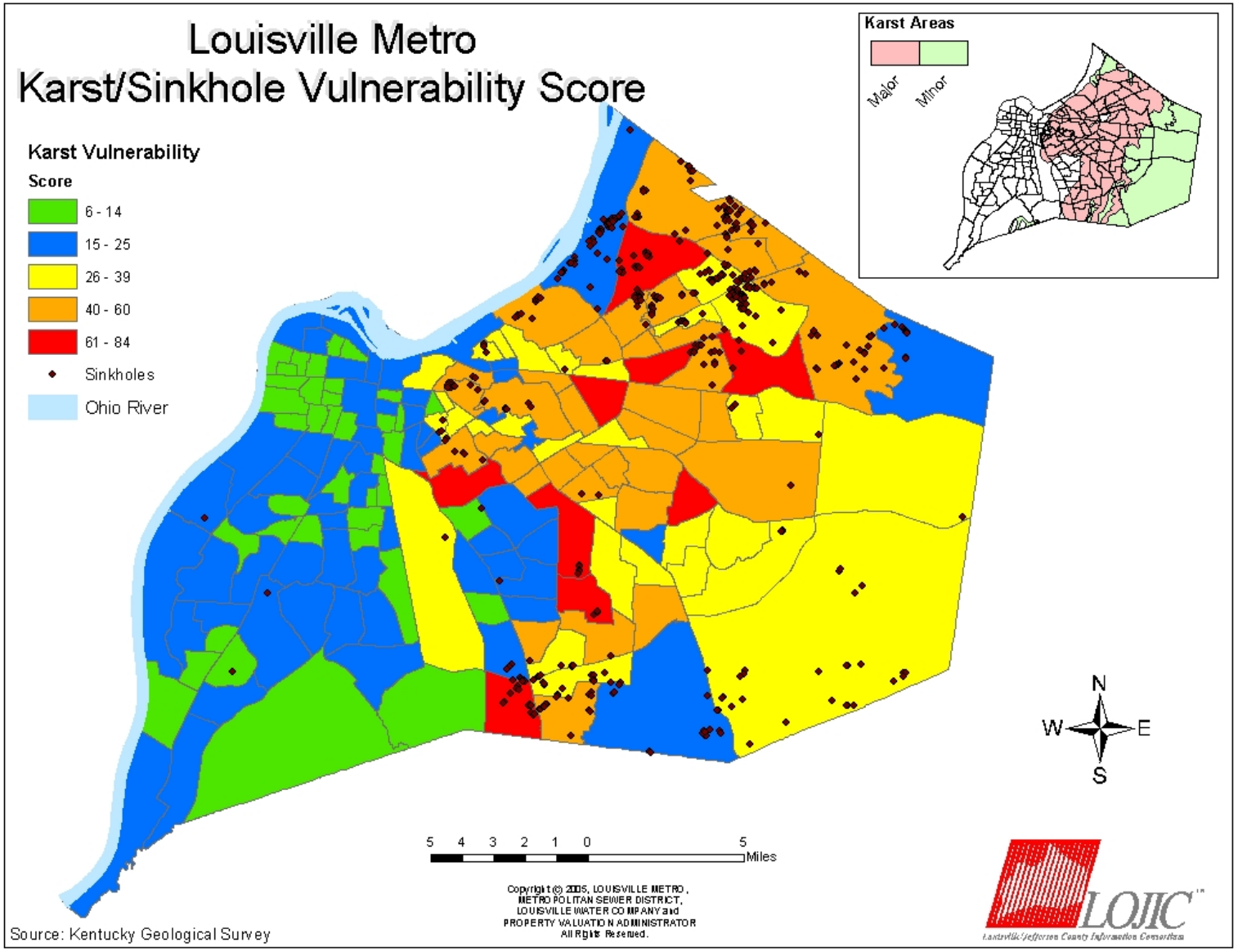
First, by using floodplain boundary data from 1994 local DFIRM data sets, each census tract's percent of area within the 100 year floodplain was determined (See Flood Vulnerability Table in Appendix 13).

Next, the census tracts were ranked 1-5 (1=low, 5=high) based upon the above percentage, producing a Hazard Score.

Finally, a 100 year Flood Vulnerability Score was calculated for each census tract by multiplying the Exposure Score by the Hazard Score.

Note: Some census tracts have 0 flood zones which equaled a 0 100 Year Floodplain Hazard Score, thus, equaling a 0 100 Year Flood Vulnerability Score.

Karst/Sinkhole Vulnerability Map



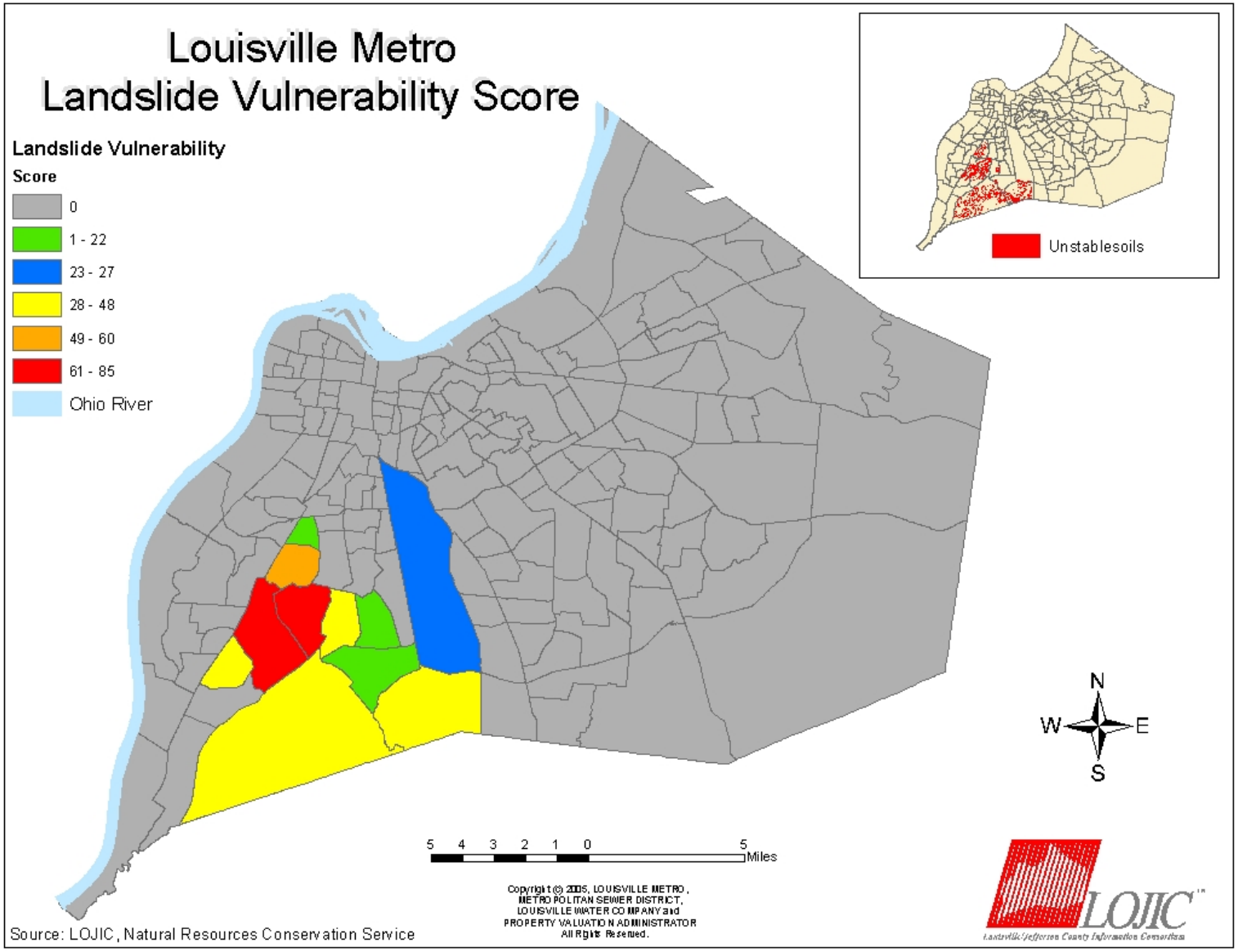
Karst/sinkhole vulnerability was determined by first, mapping Louisville Metro with the Kentucky Geological Survey's major and moderate Karst regions.

Second, those census tracts with a majority of area lying within a major Karst region received a score of 3 (See Karst/sinkhole Vulnerability Table Appendix 13). The tracts with a majority of area lying within a moderate Karst region received a score of 2 and those census tracts with a majority of area not within a major or moderate Karst region received a score of 1.

Next, the census tracts were ranked 1-5 (1=low, 5=high) based upon the above scores, producing a Hazard Score. Finally, a Karst/sinkhole Vulnerability Score was calculated for each census tract by multiplying the Exposure Score by the Hazard Score.

As shown in the map inset, sinkholes have occurred in Louisville Metro outside of the major and moderate Karst regions; thus, a likelihood of sinkhole occurrence does exist for all census tracts no matter if they are located in a major or moderate Karst region.

Landslide Vulnerability Map



Once it is known that a census tract contains an area susceptible to landslide, it must be determined how vulnerable that census tract is to landslide events.

First, areas of Louisville Metro that included a 12 percent or greater slope and unstable soils were obtained from the Natural Resources Conservation Service (NRCS).

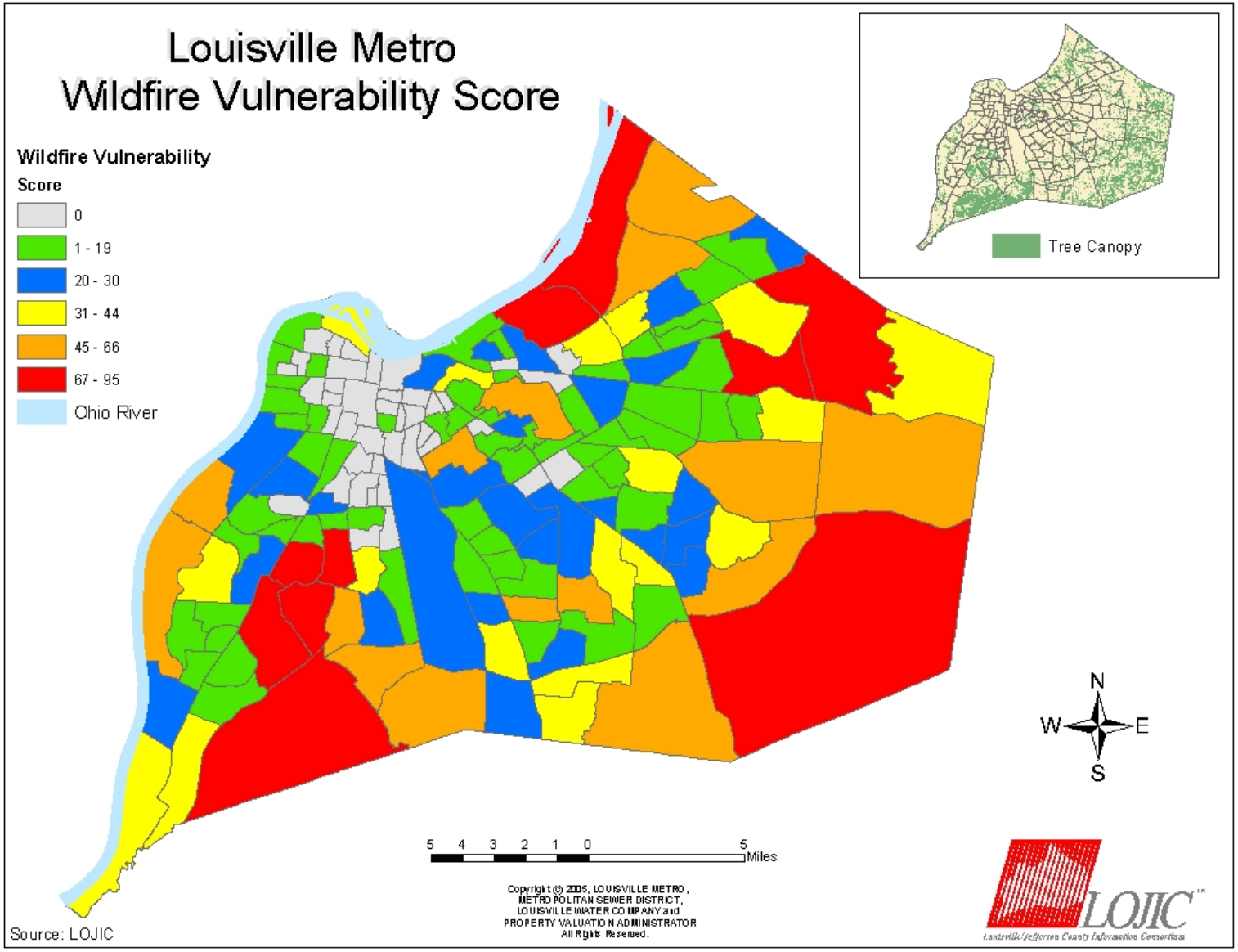
Next, these areas were mapped and a percent of area susceptible to landslide was determined for each census tract (See Landslide Vulnerability Appendix 13).

Next, the census tracts were ranked 1-5 (1=low, 5=high) based upon the above percentage, producing a Hazard Score.

Finally, a Landslide Vulnerability Score was calculated for each census tract by multiplying the Exposure Score by the Hazard Score.

Note: Some census tracts do not contain slopes of 12% or greater, so they received a 0 Landslide Hazard Score; thus, equaling a 0 Landslide Vulnerability Score.

Wildfire Vulnerability Map



A census tracts vulnerability to wildfire was determined by first, mapping those areas containing three acres or more of tree cover, derived from LOJIC databases.

Second, the percent of each census tract's area susceptible to wildfire was calculated (See Wildfire Vulnerability Table Appendix 13).

Next, the census tracts were ranked 1-5 (1=low, 5=high) based upon the above percentage, producing a Hazard Score.

Finally, a Wildfire Vulnerability Score was calculated for each census tract by multiplying the Exposure Score by the Hazard Score.

Note: Some census tracts do not contain areas susceptible to wildfire, so they received a 0 Wildfire Hazard Score; thus, equaling a 0 Wildfire Vulnerability Score.